DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

Research Foundation Flanders
Opening new horizons

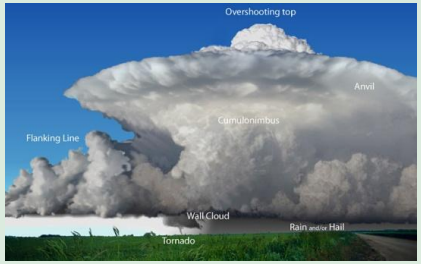
Influence of the African Great Lakes on the regional climate

W. Thiery[1], E. L. Davin[2], H.-J. Panitz[3], M. Demuzere[1], S. Lhermitte[1] and N. van Lipzig[1]

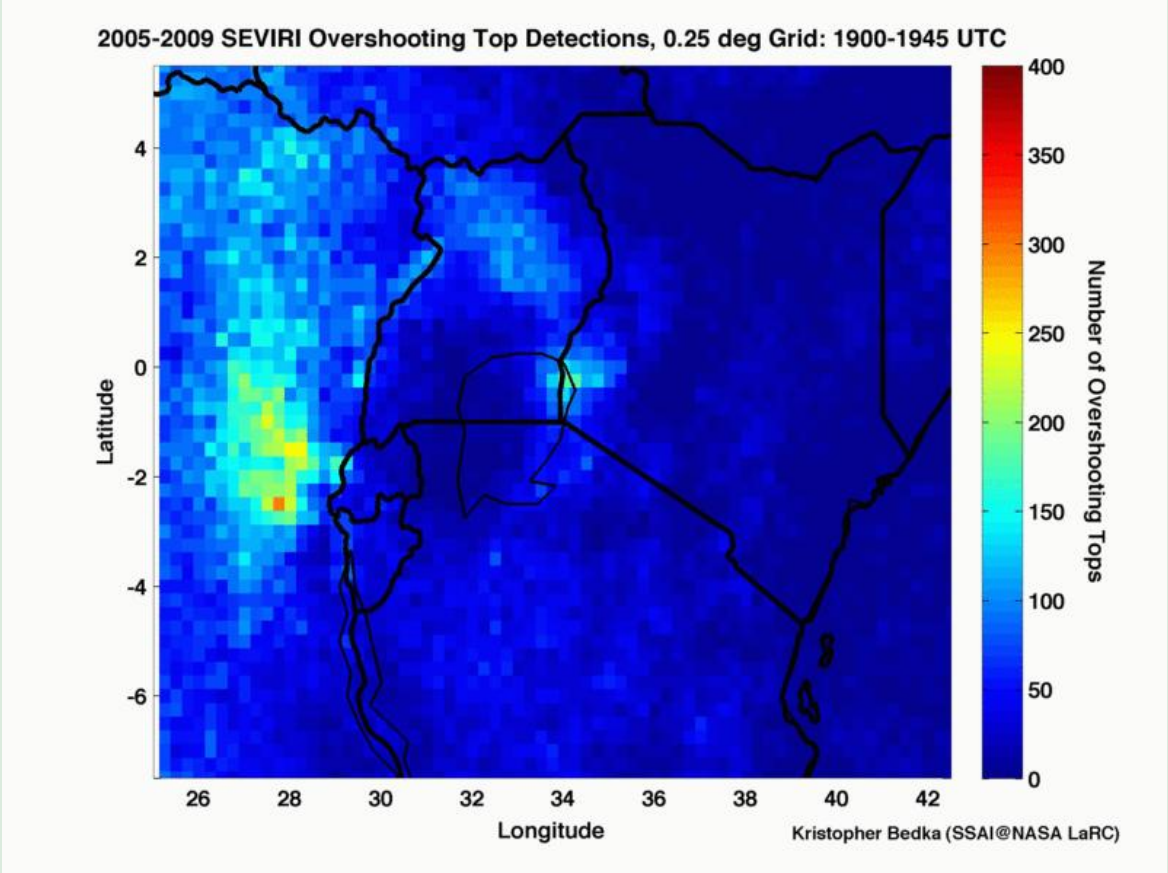
[1] EES, University of Leuven, Belgium
[2] IACETH, Swiss Federal Institute of Technology, Switzerland
[3] IMK-TRO, Karlsruhe Institute of Technology, Germany

DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

Motivation and objectives

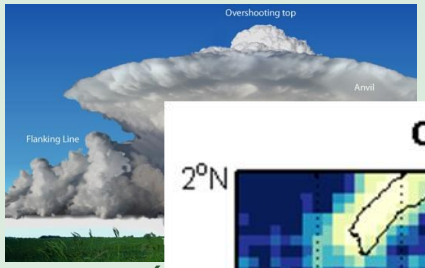


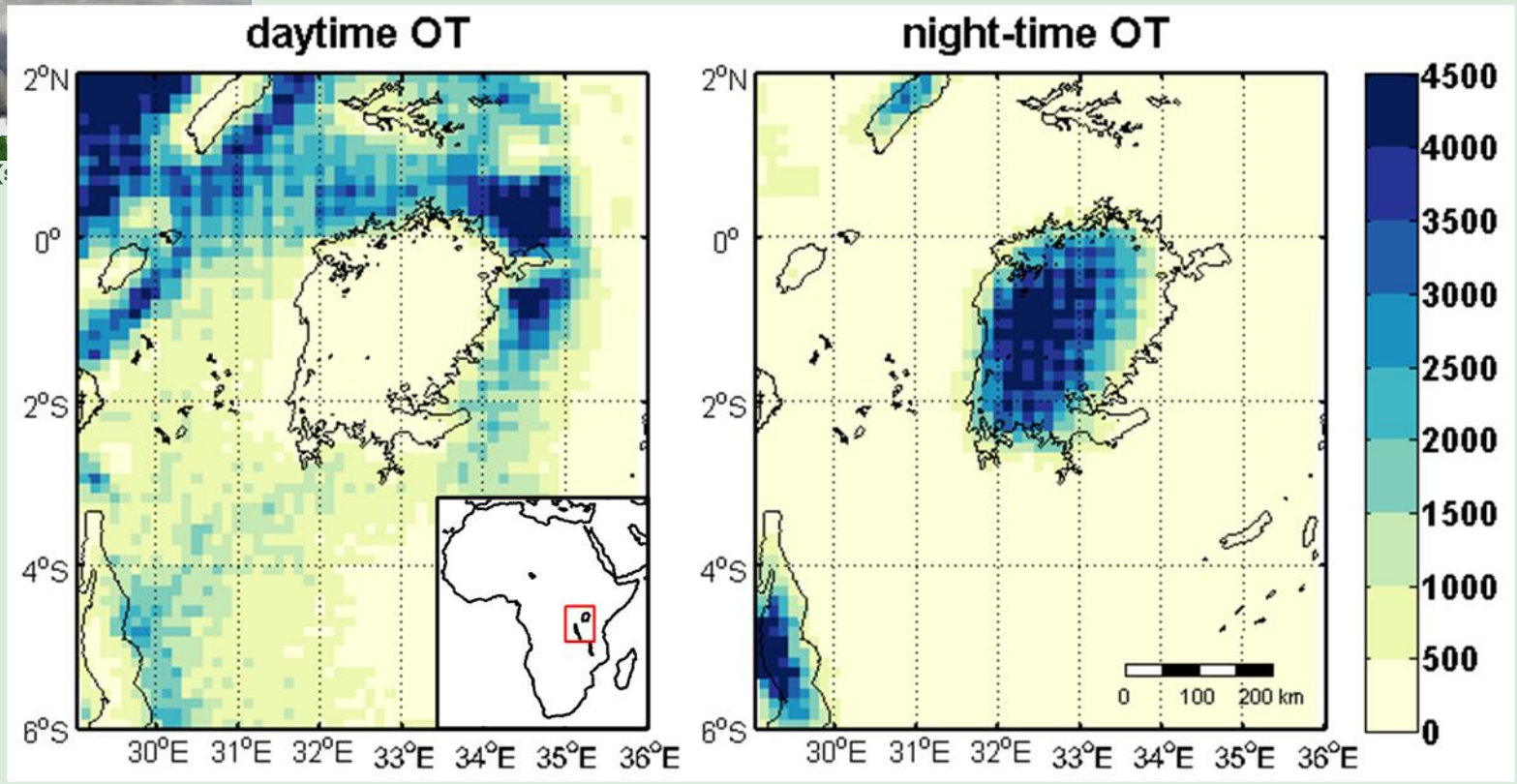
(severe-wx.pbworks.com)



DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

Motivation and objectives





clear lake imprint on thunderstorm occurrence

DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

Motivation and objectives

(Lake Kivu)

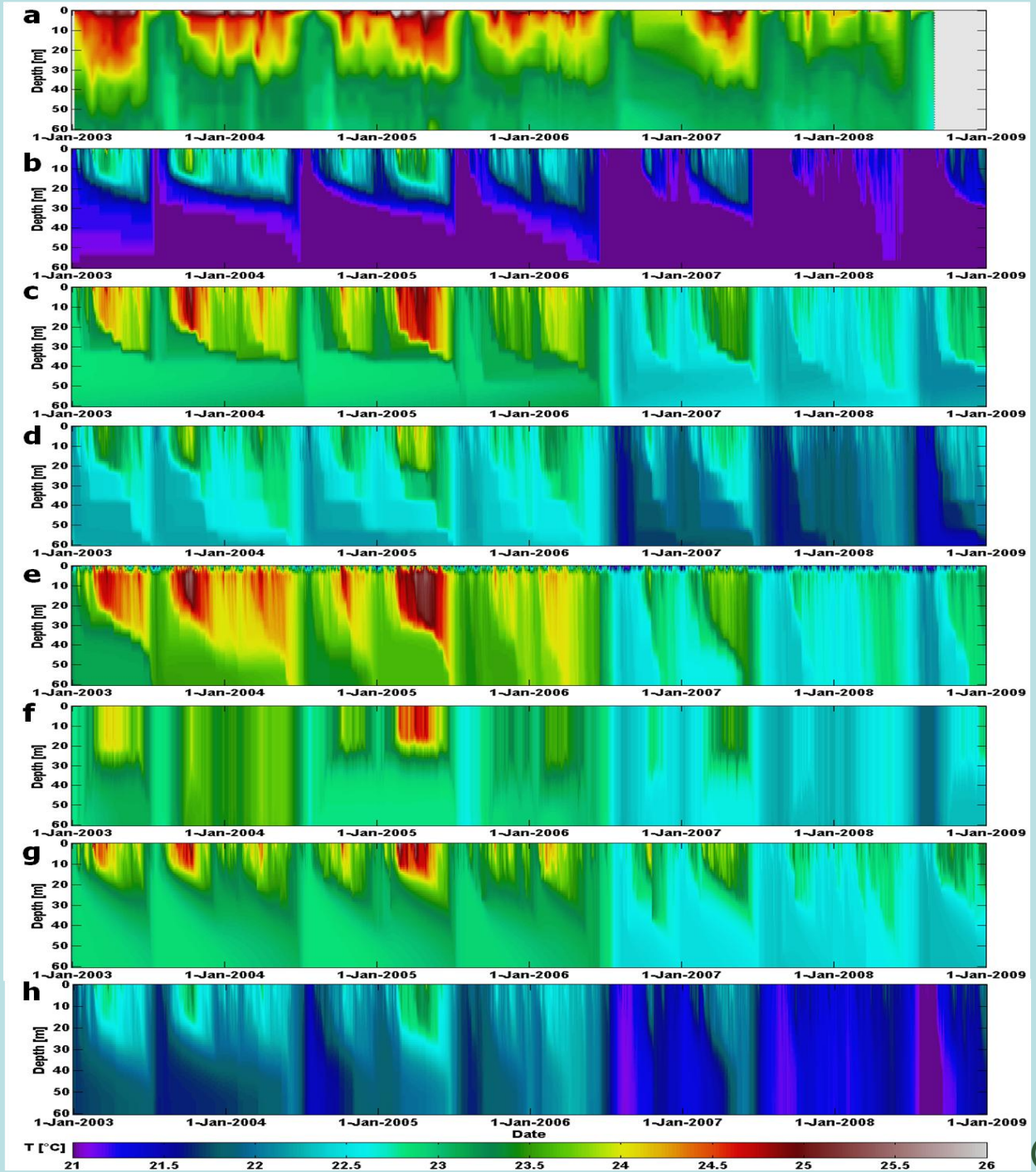
Lethal weather on 'world's most dangerous lake'

From **Errol Barnett,** CNN
January 17, 2013 -- Updated 1448 GMT (2248 HKT)

(www.cnn.com)

model skill?

impact?



observations

Hostetler

LAKEoneD

SimStrat

LAKE

FLake

MINLAKE2012

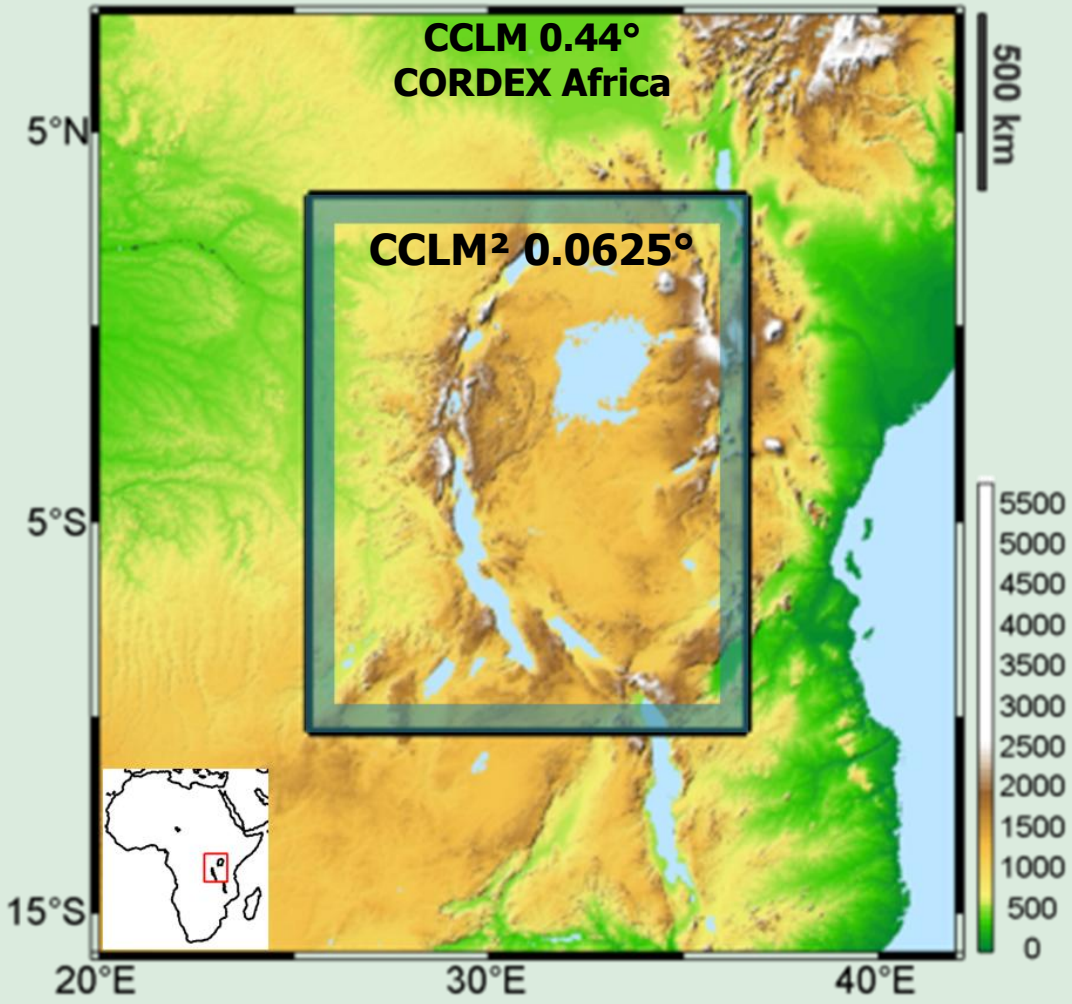
CLM4-LISSS

Although T_{bot} is extremely sensitive to extpar and forcing, T_{surf} predictions are robust (Thiery et al., GMD 2014)

(Thiery et al., TA 2014)

DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

CCLM² model setup



COSMO-CLM 4.8
(CORDEX-Africa set-up)

CLM 3.5 | FLake

(Davin and Seneviratne, 2012)

"NDL" (1999–2008)

How well does our model perform?

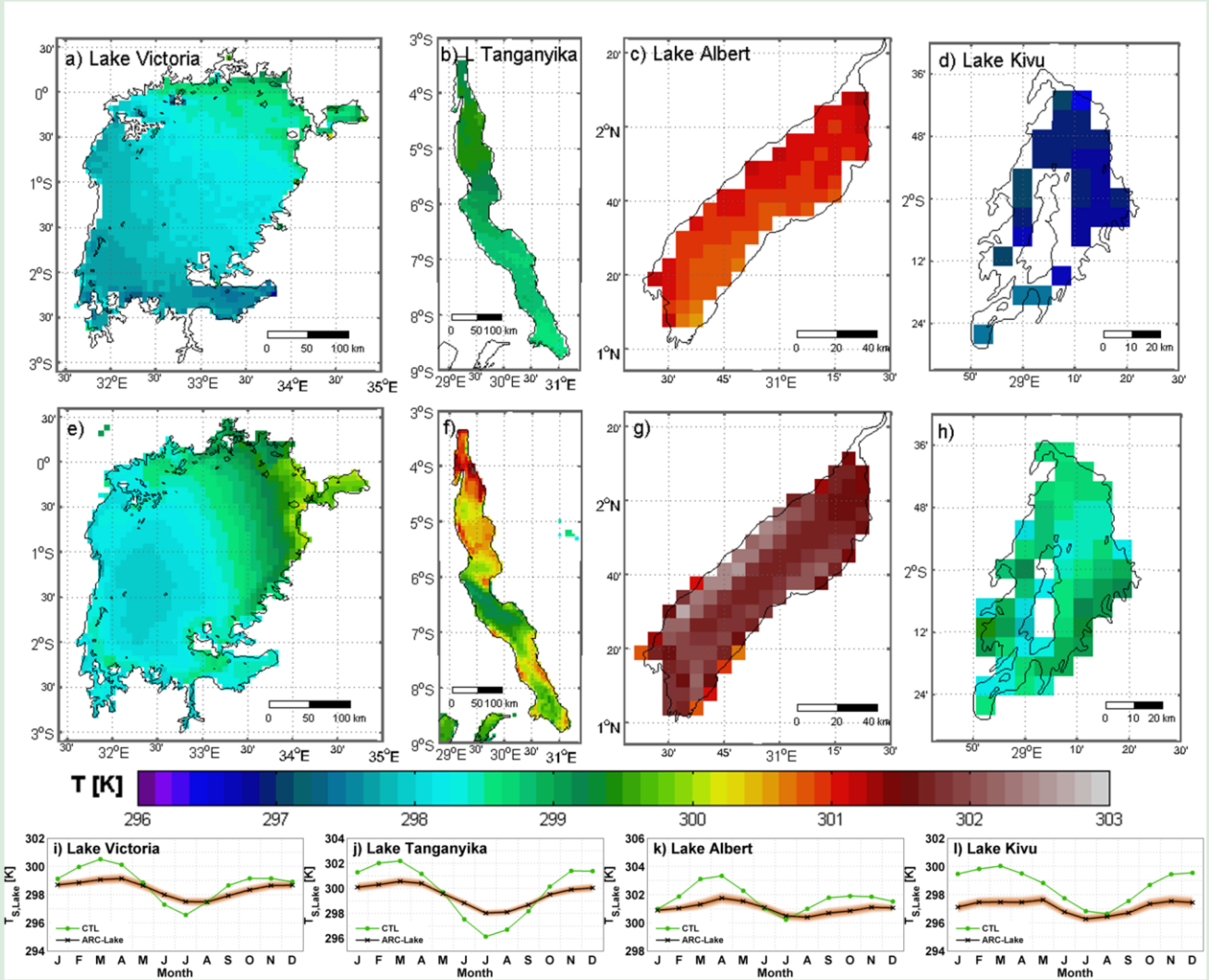
COSMO-CLM 4.8

CLM 3.5 FLake

Evaluation: lake temperature

OBS

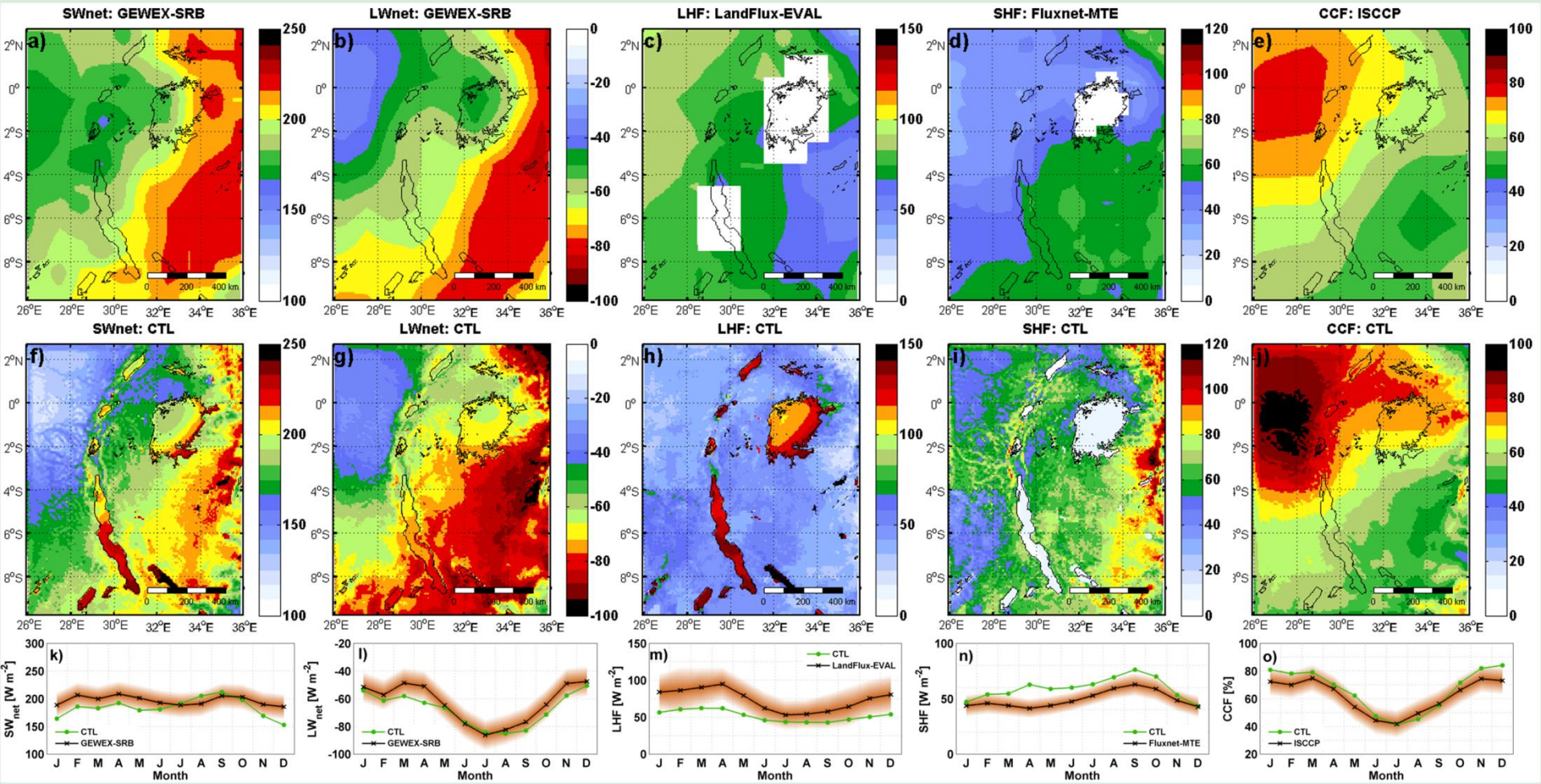
CTL



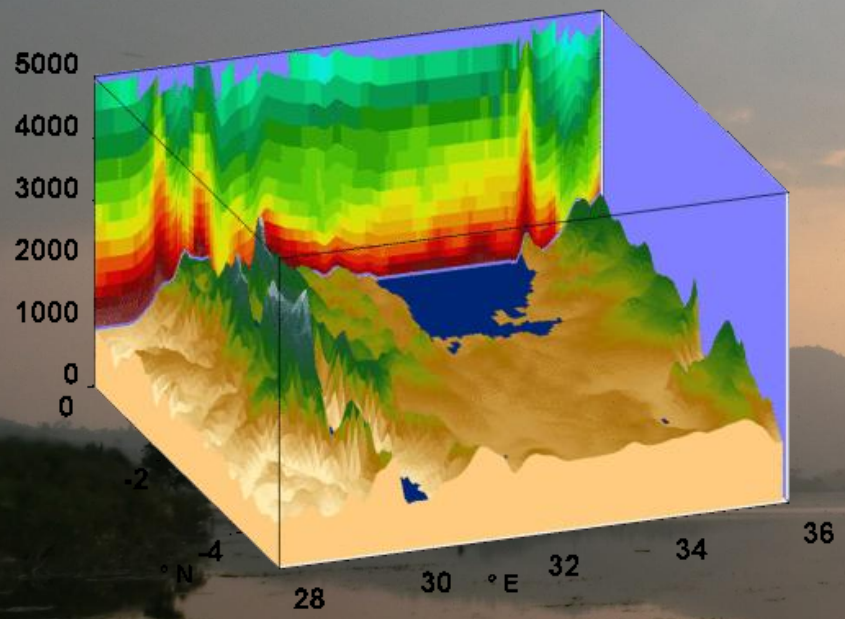
COSMO-CLM 4.8

CLM 3.5 FLake

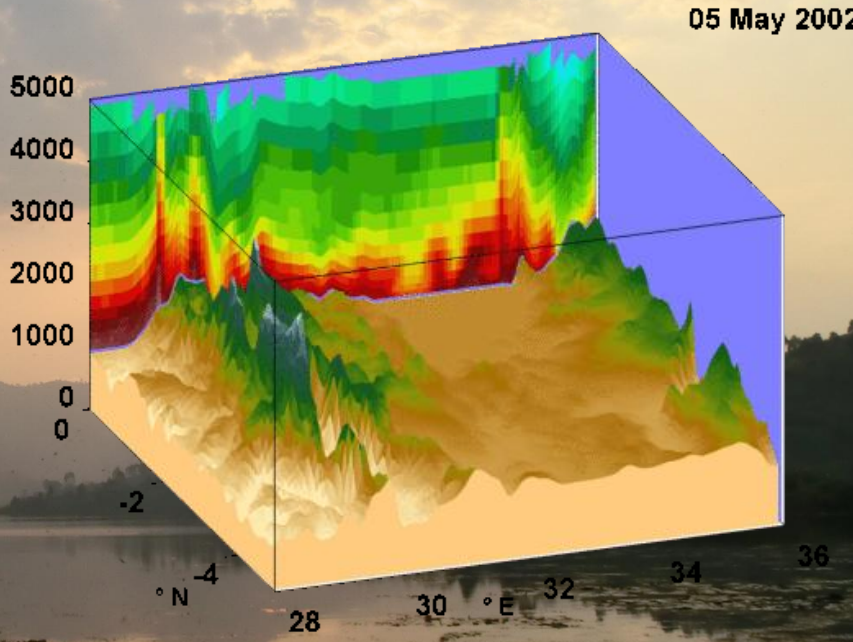
Evaluation: SEB and clouds



Impact on the regional climate?



"CTL"



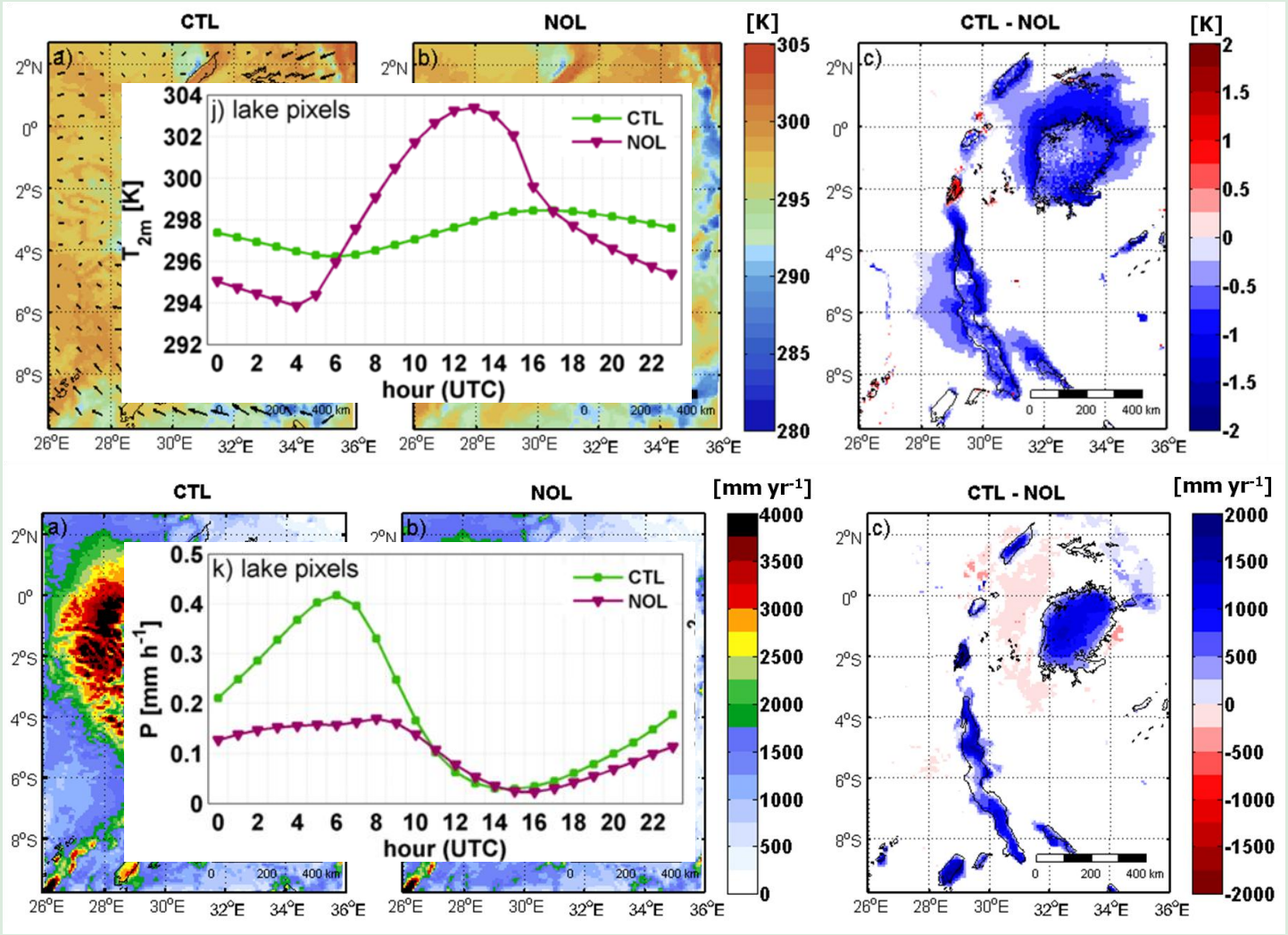
"NOL"

DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

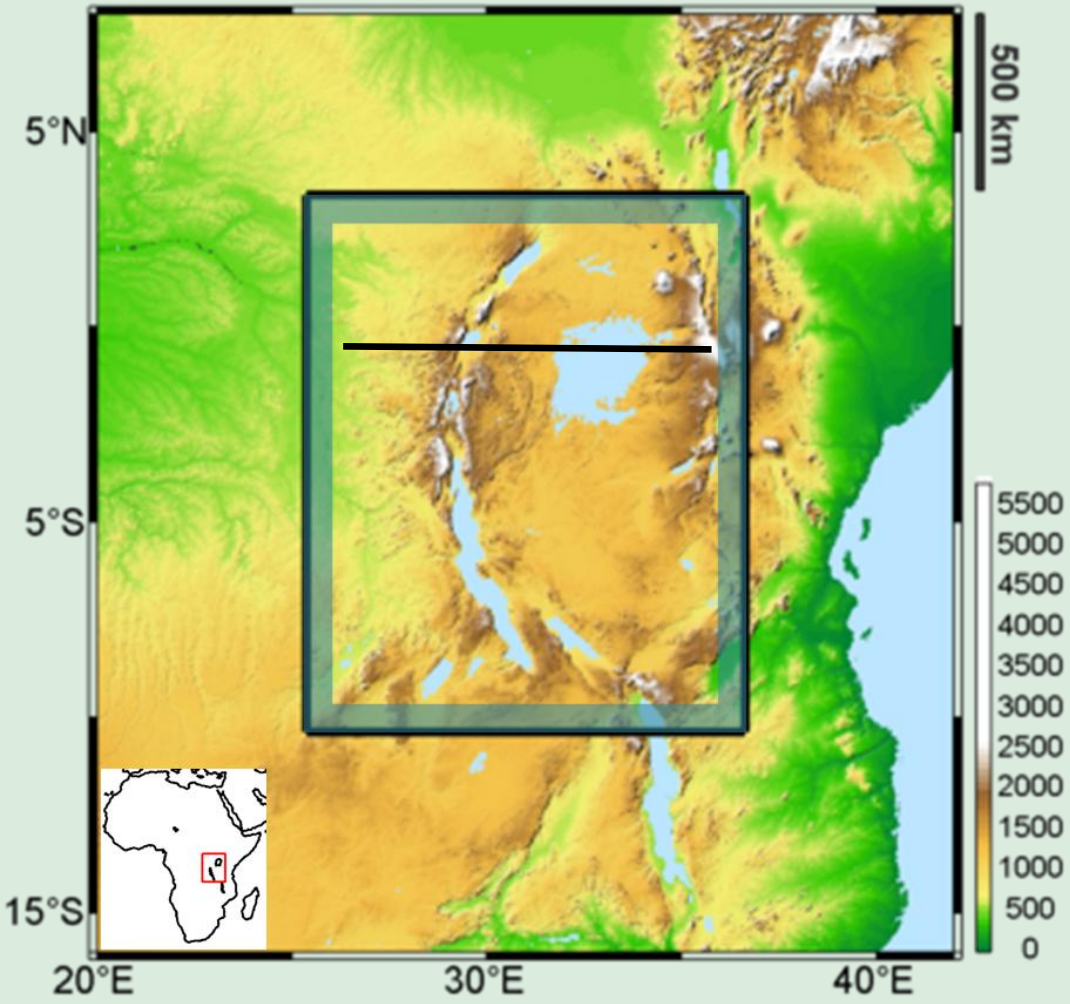
AGL impact on the mean climate

T_{2m}

Precipitation



Cross section

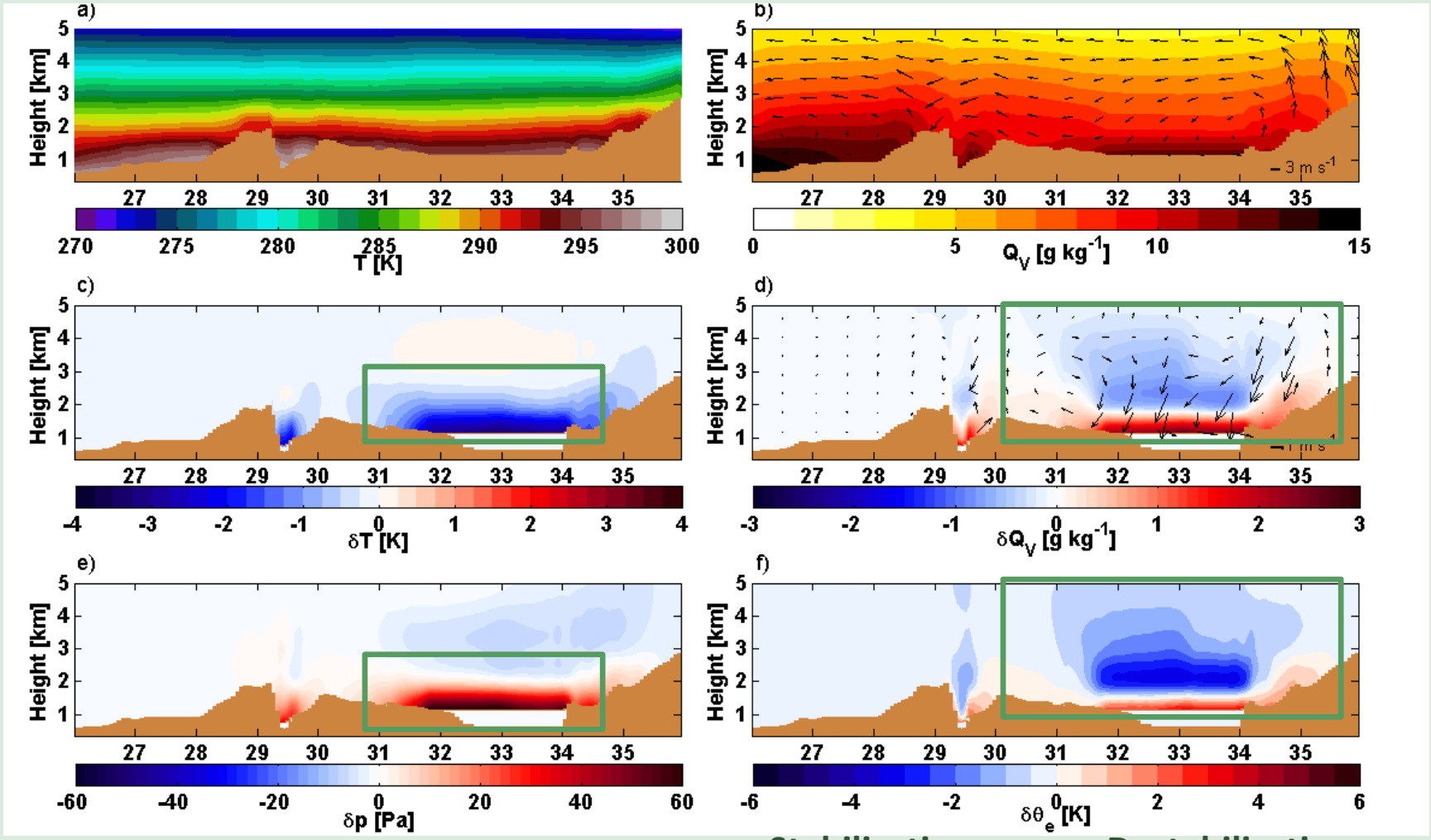


DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

Dynamical response: daytime

CTL

CTL - NOL



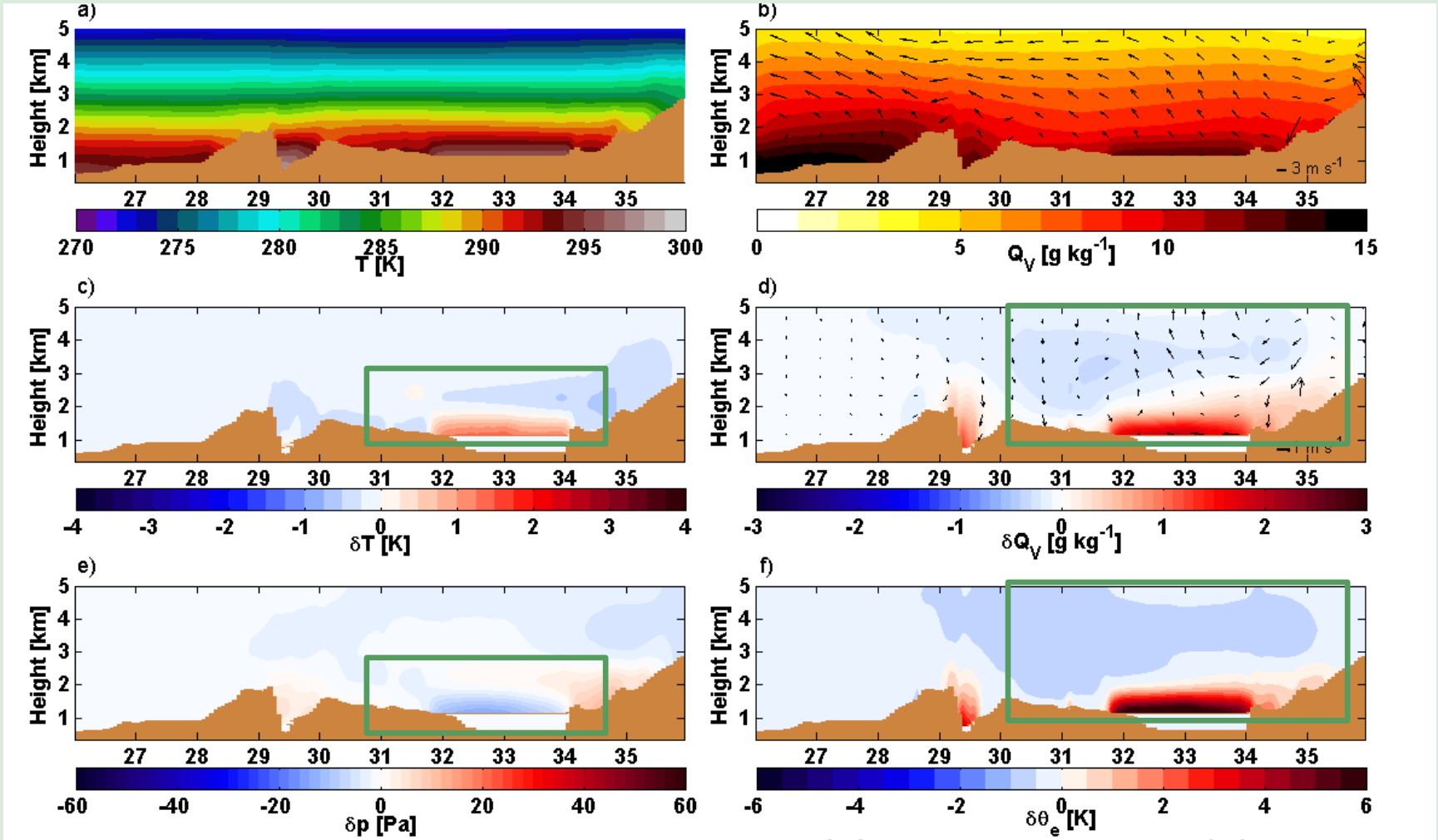
Stabilisation **Destabilisation**

DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

Dynamical response: night-time

CTL

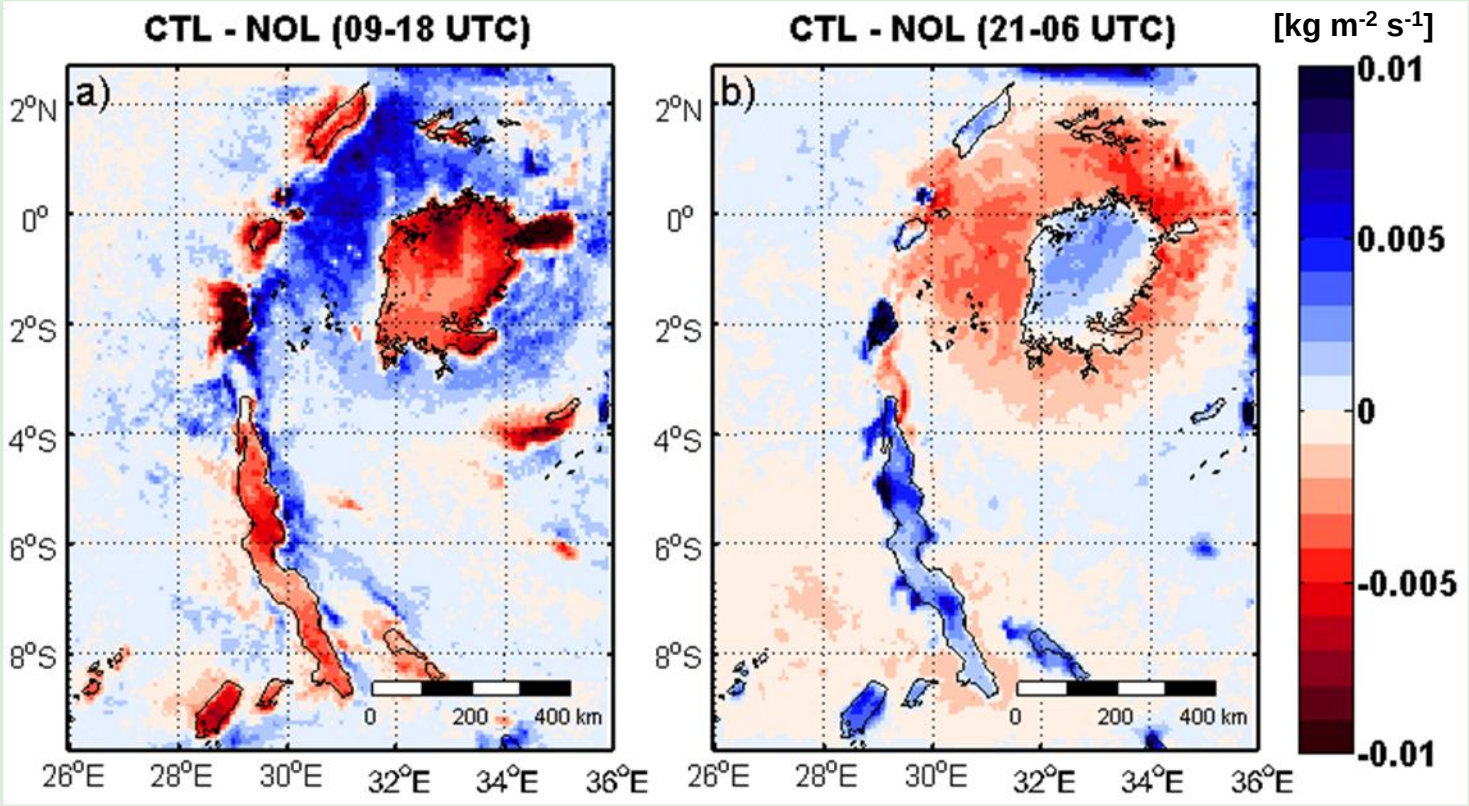
CTL - NOL



Stabilisation **Destabilisation**

DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

Change in convective mass flux density at cloud base height



Thank you for your attention

Thiery, W., Davin, E.L., Panitz, H.-J., Demuzere, M., Lhermitte, S., and van Lipizg, N.P.M., 2015: The impact of the African Great Lakes on the regional climate, J. Climate, doi: 10.1175/JCLI-D-14-00565.1.

Acknowledgements: FWO, BELSPO

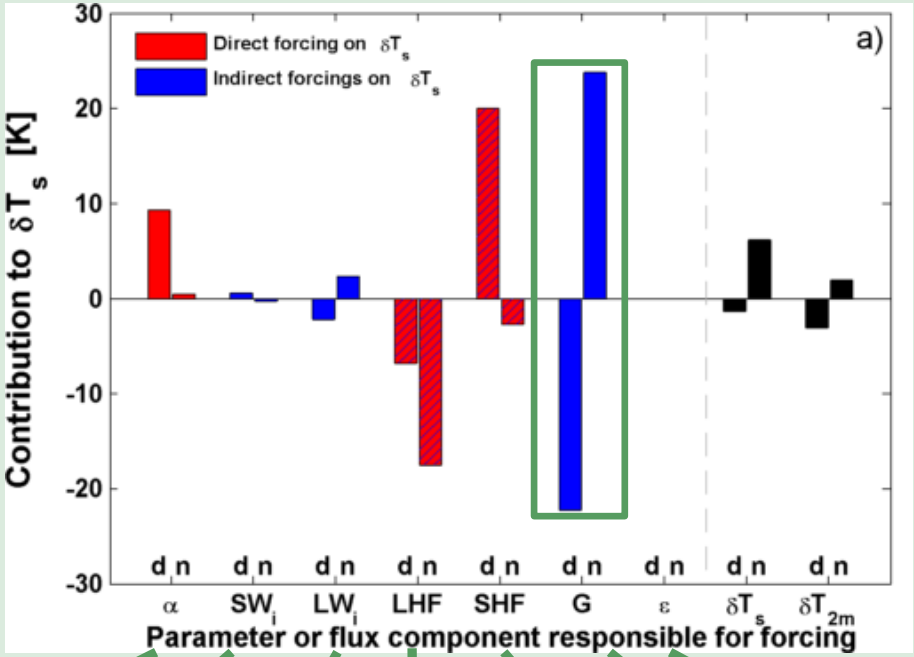
wim.thiery@ees.kuleuven.be

Conclusions

- CCLM² 0.0625° simulation fairly reproduces the AGL climate and …
- … even outperforms a state-of-the art reanalysis and RCM simulation.
- AGL exert profound influence on near-surface temperature and precipitation…
- … through its impact on the SEB and mesoscale circulation

SEB decomposition: day-night contrast

Lake pixels



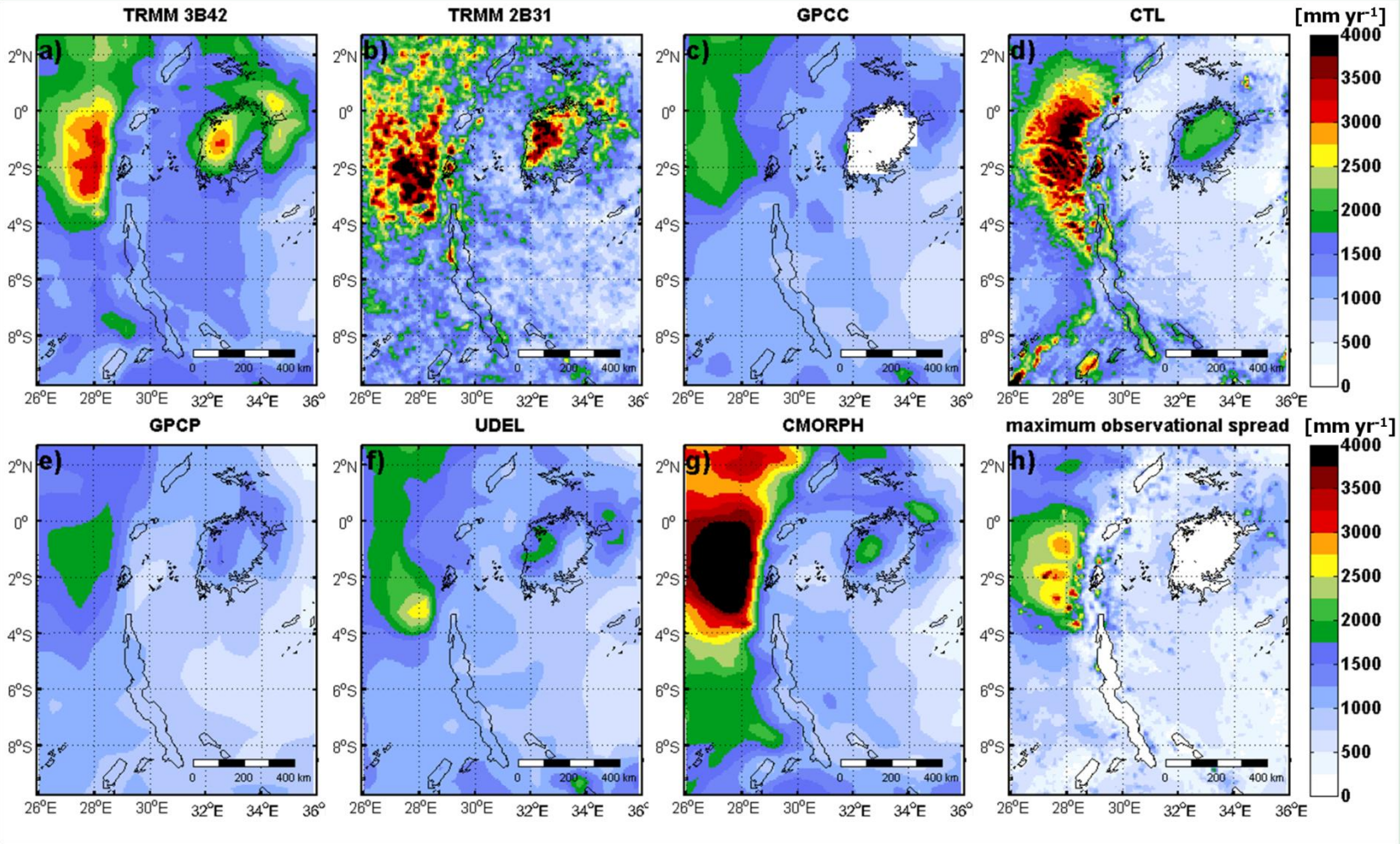
$$\delta T_s = \frac{1}{4\epsilon\sigma T_s^3}(-SW_{in}\delta\alpha + (1-\alpha)\delta SW_{in} + \delta LW_{in} - \delta LHF + \delta SHF - \delta G - \sigma T_s^4 \delta\epsilon)$$

(Akkermans et al., 2014)

COSMO-CLM 4.8

CLM 3.5 FLake

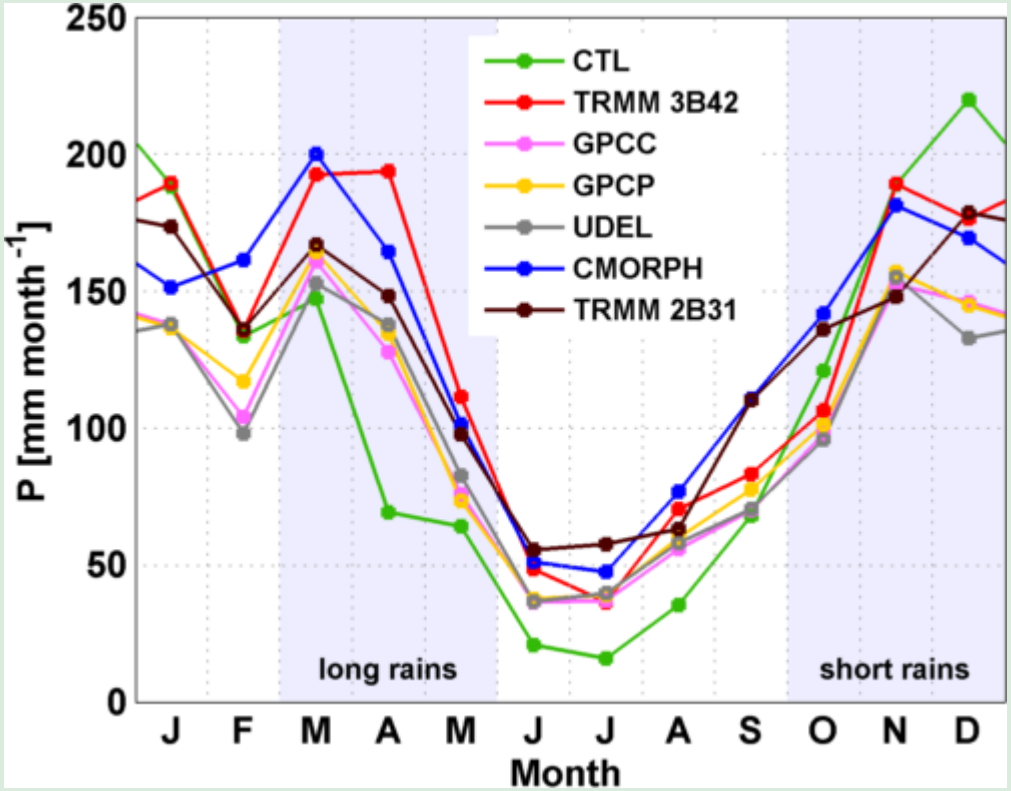
Evaluation: precipitation



COSMO-CLM 4.8

CLM 3.5 FLake

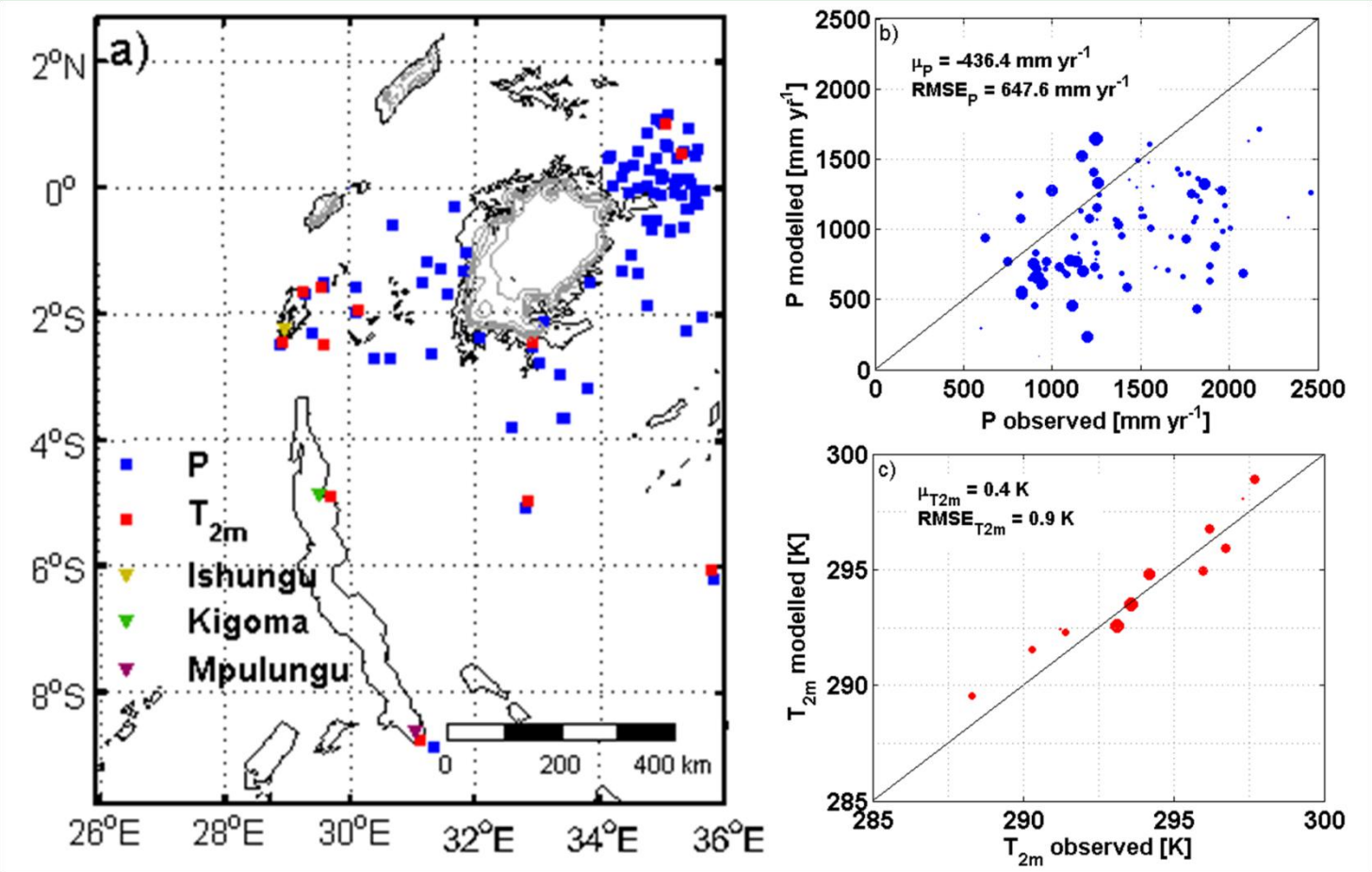
Evaluation: precipitation

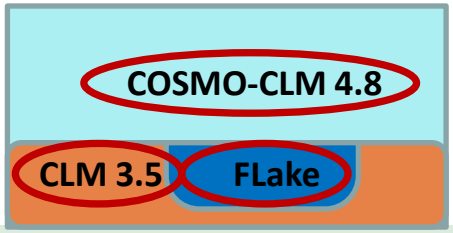


COSMO-CLM 4.8

CLM 3.5 FLake

Evaluation: precipitation





Evaluation: precipitation

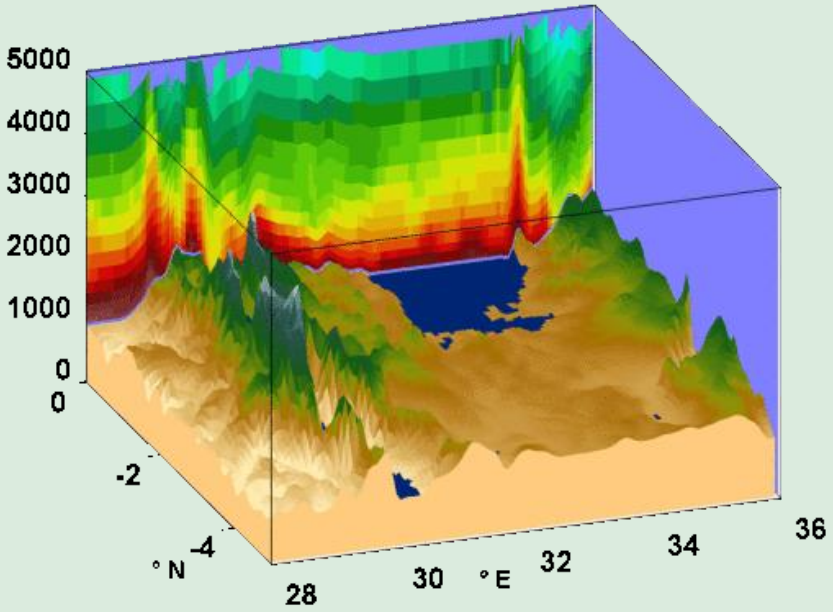
CTL ERA-Interim CORDEX

Physical quantity [Units]	COSMO-CLM^2		ERA-Interim		CORDEX	
	bias	RMSE	bias	RMSE	bias	RMSE
TRMM 3B42 Precipitation [mm yr^{-1}]	-261	683	612	881	-717	838
GPCC Precipitation [mm yr^{-1}]	68	631	941	1160	-389	508
GPCP Precipitation [mm yr^{-1}]	30	554	903	1069	-427	519
UDEL Precipitation [mm yr^{-1}]	84	604	957	1167	-373	478
CMORPH Precipitation [mm yr^{-1}]	-330	712	739	907	-771	973
TRMM 2B31 Precipitation [mm yr^{-1}]	-273	678	599	873	-730	927
ensemble Precipitation* [mm yr^{-1}]	-116	554	757	932	-573	669
GEWEX-SRB SW_{net} [W m^{-2}]	-12	22	39	42	-26	33
GEWEX-SRB LW_{net} [W m^{-2}]	-5	8	-21	24	1	7
LandFlux-EVAL LHF [W m^{-2}]	-22	34	32	35	-27	31
Fluxnet-MTE SHF [W m^{-2}]	10	22	-2	15	6	23
ISCCP CCF [%]	4	7	-1	6	3	6
ARC-Lake LSWT Victoria [K]	0.40	0.53	-4.16**	4.52**	-2.70	2.81
ARC-Lake LSWT Tanganyika [K]	1.09	1.16	-7.58**	7.82**	-3.07	3.35
ARC-Lake LSWT Albert [K]	0.90	0.94	/	/	-5.90	5.94
ARC-Lake LSWT Kivu [K]	1.80	1.83	/	/	-4.19	4.19

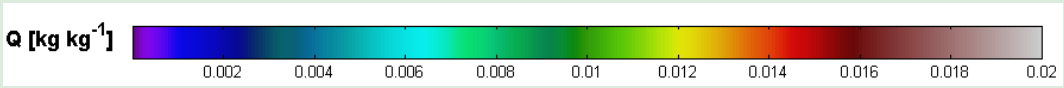
* Average of the 6 gridded precipitation products.
** Given the coarse resolution of this product and associated limited number of lake pixels, nearest neighbour interpolation was used in this case instead of bilinear interpolation.

DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

Added value of our simulations



"CTL"



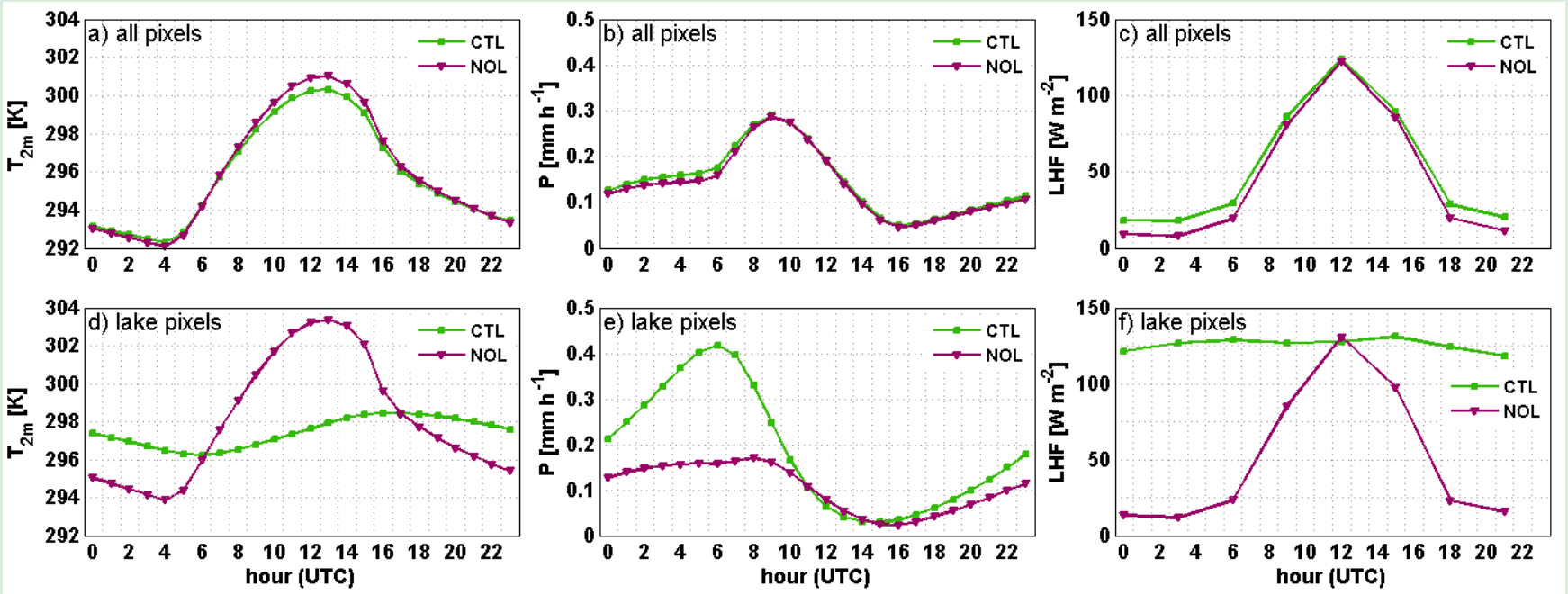
DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCES
K.U.LEUVEN - BELGIUM

AGL impact on the diurnal cycle

T_{2m} | precipitation | LHF

All pixels

Lake pixels



SEB decomposition

$$\epsilon\sigma T_s^4 = (1-\alpha)SW_{in} + LW_{in} - LHF - SHF - G$$

$$\delta T_s = \frac{1}{4\epsilon\sigma T_s^3}(-SW_{in}\delta\alpha + (1-\alpha)\delta SW_{in} + \delta LW_{in} - \delta LHF + \delta SHF - \delta G - \sigma T_s^4 \delta\epsilon)$$

(Akkermans, Thiery & van Lipzig, JC 2014)

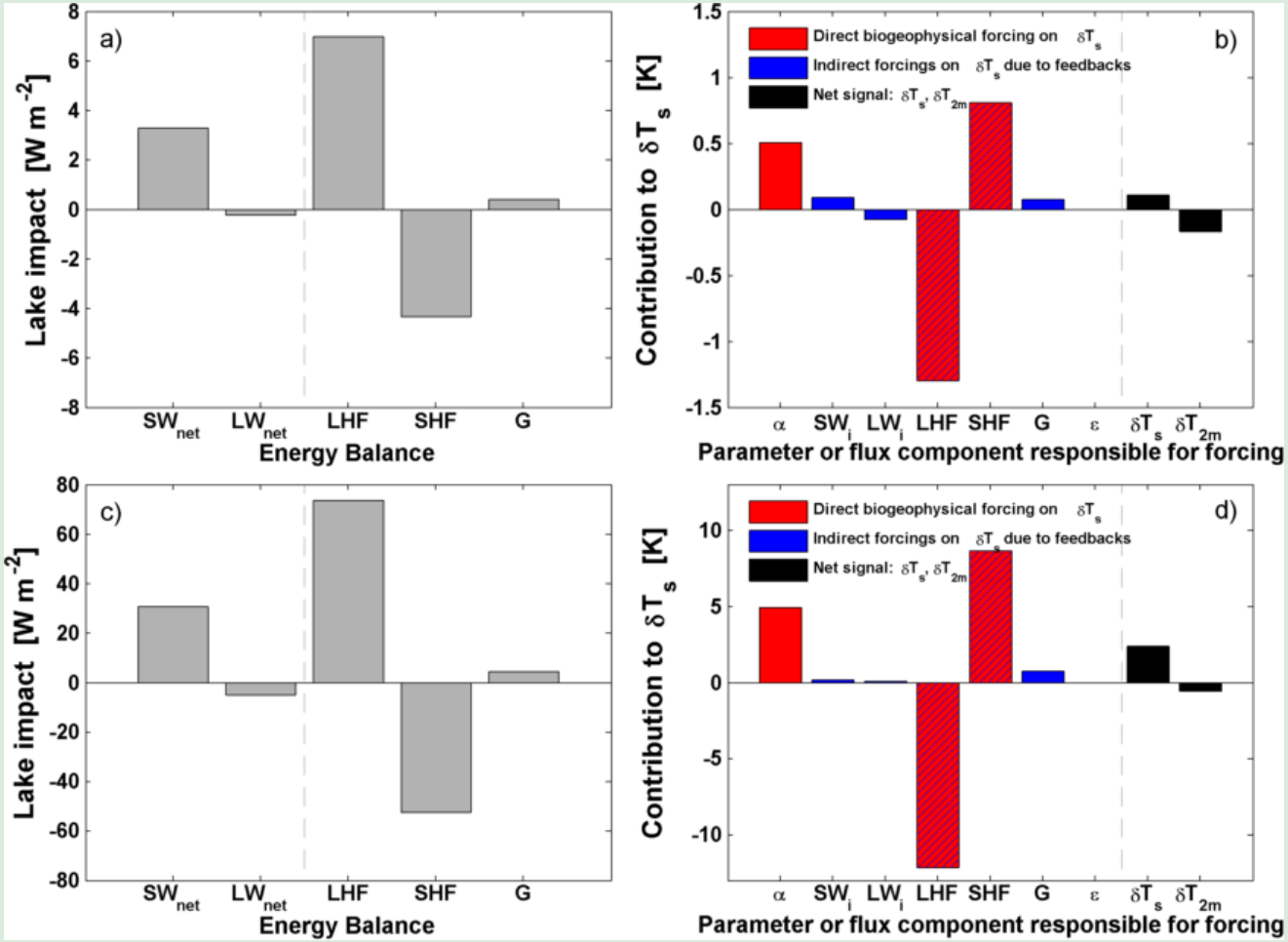
DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
K.U.LEUVEN - BELGIUM

SEB decomposition

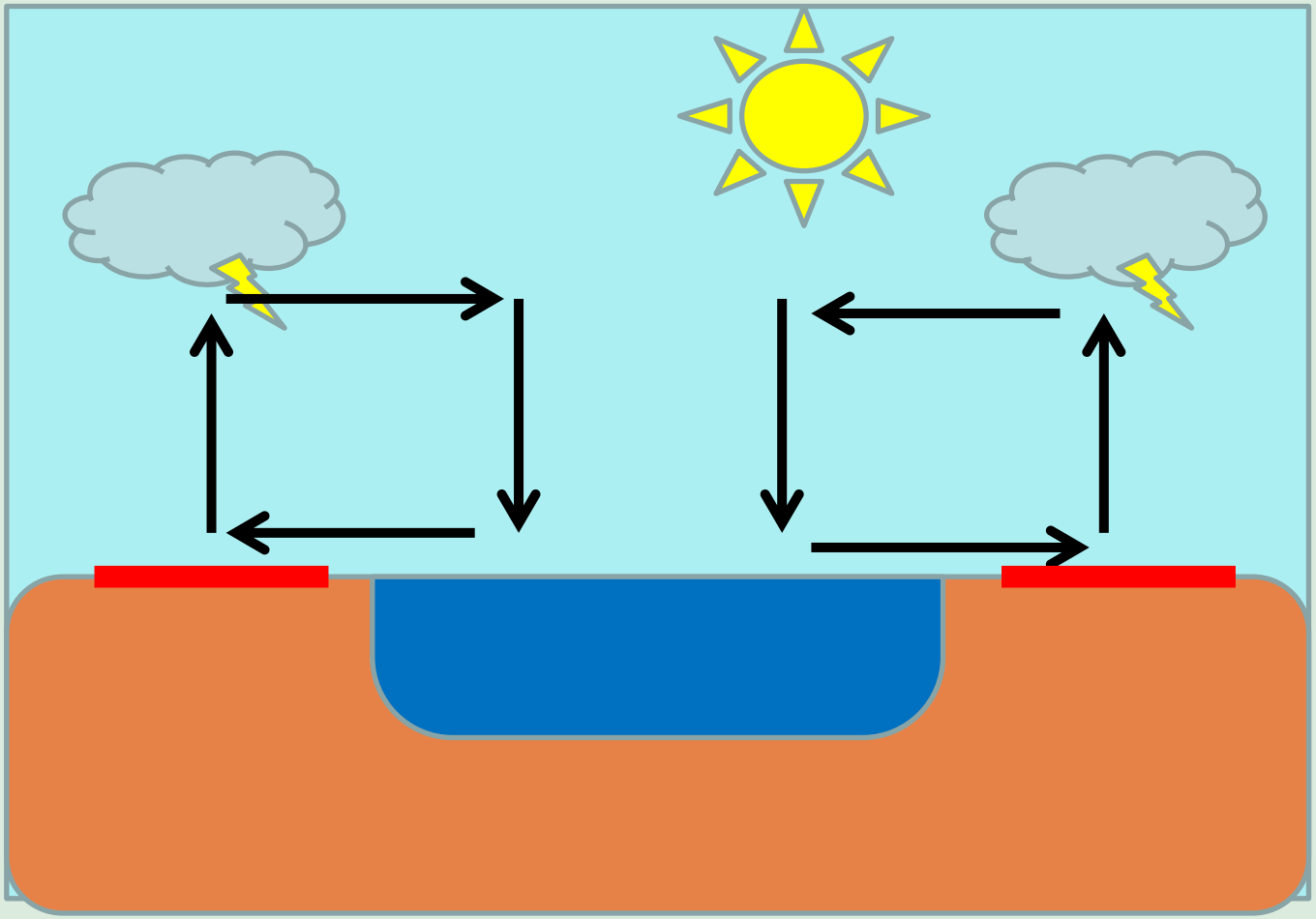
$$\delta T_s = \frac{1}{4\epsilon\sigma T_s^3}(-SW_{in}\delta\alpha + (1-\alpha)\delta SW_{in} + \delta LW_{in} - \delta LHF + \delta SHF - \delta G - \sigma T_s^4 \delta\epsilon)$$

All pixels

Lake pixels



Lake breeze



Land breeze